In a sustainable society, rail transport should play a far greater role than it does today. In order to facilitate this, the capacity of the existing railway system needs to be increased. The objective of the project SUSTAINABLE BRIDGES, was to concentrate on the part played by bridges in meeting this need and was focused on three specific goals. The first goal was to increase the transport capacity of existing bridges by allowing higher axle loads (up to 33 tons) for freight traffic at moderate speeds or by allowing higher speeds (up to 350 km/hour) for lighter passenger traffic. The other goals were to increase the residual service lives of existing bridges by up to 25 % to enhance management, strengthening, and repair systems. All this will produce savings financial savings throughout Europe.
The consortium brought together experience of the different types of challenges facing European railways. In central Europe, flooding from big rivers crossing a flat landscape is a major problem, whereas frost damage predominates in northern Europe. There are also different demands on railway lines; heavy iron ore traffic crossing the wilderness of northern Scandinavia and intense passenger traffic in the densely populated areas of central Europe and the United Kingdom. A group of railway owners mapped the existing stock of railway bridges and made an overview of relevant problems. The data from the survey covers over 220,000 bridges owned by 17 different railways and is considered to be representative of the well in excess of 300,000 railway bridges across Europe.

Mapping showed that masonry arches formed a larger portion of the existing bridge stock than had been originally envisaged. Consequently, the project plan was revised to allocate more resources to the study of arch bridges. Results were exchanged with a masonry arch bridge project run by the International Union of Railways (UIC) to minimise duplication of research effort. Tests at bridges in Germany, Poland and Sweden have been performed. To make information more readily accessible to bridge engineers a toolbox listing available measurement techniques has been produced. In addition, proposals for the use of measurement techniques in condition assessment systems and suggestions for a unified defect classification scheme have been made.

A second group evaluated existing monitoring techniques (sensors, data communication and data processing) and carried out research into wireless sensor networks based on fibre optical sensor technologies and micro electro-mechanical systems (MEMS). Fibre optical sensors fit well in railway bridge applications because of their high immunity to electromagnetic fields. MEMS, consisting of small integrated devices or systems that combine electrical and mechanical components, can significantly reduce the cost of monitoring. A long term field test has been carried out on the Stork Bridge outside Zürich; an open access web page (see http://www.nomotida.net online) contains graphical representations of the measurements.

A third group prepared a guideline for load and resistance assessment of existing European railway bridges. This guideline is supported by a large number of background documents, which represent the major scientific outputs from this work stream. A fourth group studied repair and strengthening methods by carrying out many laboratory based investigations. The group focused on repair and strengthening methods that do not require long term bridge closures, that are environmentally friendly and which can be economically justified. Hence, carbon fibre reinforced polymers (CFRPs) were the main focus of the research. The group produced a guideline on the most popular repair and strengthening methods and explaining the use of CFRPs in more detail for the benefit of those unfamiliar with the material.

Two further groups worked with demonstration and testing on existing bridges. Their original plans were modified in order to integrate the test needs of other groups. A steel bridge in France, a concrete bridge in Sweden and a masonry bridge in Poland were tested and the results evaluated for comparison with predicted values. Monitoring methods were tested on five other bridges. In one case measurement of the real dynamic amplification factor showed that the bridge could carry a desired higher load well above predictions with existing codes.

The project results will reduce costs by making it possible to increase the usage and extend the residual
service lives of existing bridges. With more than 300 000 bridges, having a total value of around 50 billion Euros, a moderate 2 % increase in load capacity, or residual life, would result in savings of the order of EUR 1 billion. The whole project cost will be recouped with only ten ordinary bridges being saved / strengthened instead of being torn down and replaced by new bridges.

The results will also be useful for road bridges, which more than double the value of the project. In conclusion, all three of the project’s specific goals have been met, i.e. increased bridge capacity and length of life and enhanced methods for maintenance, repair and strengthening. Knowledge and know-how resulting from the project will be used by rail authorities, consultants and contractors. Information has been disseminated to a wider audience through training programs, workshops, conferences and a website.

Related documents

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